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Can Theories of Self-Organization Help Us Understand Human History?

by Manuel DeLanda

Why not China? Why not Islam? Why did the power of Europe (and its ex-colonies) ended up prevailing in this millennium?. In the last few decades these questions have acquired a new significance as Western historians shed some of their Eurocentrism and tackle the problem of explaining why those two empires lost the technological, economic and scientific lead they had less than five hundred years ago. One answer to these questions may come from the comparative approach to the history of urban phenomena. For instance, a hypothesis proposed by the historian Fernand Braudel and some of his followers is that a comparison between medieval Western towns, on one hand, and those of Islamic and Chinese towns, on the other, reveals a strikingly different dynamic . While the growth and change of non-Western towns was fairly linear, Western urban dynamics was characterized by self-stimulating processes of different kinds. Or as Braudel puts it, there was a "dynamic pattern of turbulent urban evolution in the West, while the pattern of life in cities in the rest of the world runs in a long, straight and unbroken line across time." {1}.

How can we interpret this claim? Is the word “turbulence” here being used in a purely metaphorical way? The inhabitants of cities from ancient times have engaged in two quite different types of activities, one characterized by centralized decision-making, the other by multiple decisions made in a decentralized way. Roughly, those functions we associate with the government of cities (and states) are of the first type, while those related to trade are of the second type. Although most cities include human activities of both kinds, some urban centers tend to be dominated by one or another of these types of activities, becoming either the capital or organizing center of a hierarchy of towns (Paris, Madrid, Vienna), on one hand, or a gateway to foreign markets linked into a transnational network (Venice, Genoa, Lisbon, Amsterdam), on the other. (There are also, mixtures of the two, perhaps best exemplified by London). These are all European examples, but there are also instances of both landlocked capitals and maritime gateways in China and Islam. Braudel’s claim may then be interpreted the following way: different proportions of capital ïs and gateways in the West and China/Islam gave rise to different urban dynamics, with explosive, self-stimulating growth occurring only where the amount of hierarchical component in the mixture was not too high. William McNeill is another historian who thinks that in these different mixtures lies one of the reasons for the West's eventual conquest of the millennium. He refers not to turbulent dynamics occurring at the level of urban centers but to those happening at the level of institutions within those centers:

"The fact that China remained united politically from Sung to modern times...is evidence of the increased power government personnel wielded . Discrepancies between the ideas of the marketplace and those of government were real enough; but as long as officials could bring overriding police power whenever they were locally or privately defied, the command element in the mix remained securely dominant...For this reason the autocatalytic character that European commercial and industrial expansion exhibited between the eleventh and the nineteenth century never got started in China." {2}

The basic idea is then that, whether one is considering the urban dynamics of an entire geographical area (Europe, China), or whether one focuses on smaller scale phenomena, such as the dynamics of institutional ecologies within urban centers (bureaucracies, markets), turbulent, self-stimulating, autocatalytic processes cannot emerge when centralized components overwhelm decentralized ones. There are at least three separate ideas contained in these two quotations (or more exactly, in the philosophies of history of these two historians) that bear on the question of how theories of self-organizing processes can serve as a guide to interpret human history.

1) The theories of self-organization that have been developed in the last few decades (to explain the spontaneous emergence of wholes that are more than the sum of their parts) apply first and foremost to physical, chemical and biological phenomena. In these three realms there are a variety of processes displaying emergent, collective activity, which cannot be accounted for by the old, mechanistic versions of the hard sciences. Two often quoted examples are the coherent waves and oscillations that occur in certain chemical reactions and the coherent collective behavior of ant and termite colonies. But the question is, can the ideas that apply to populations of molecules or insects be used to model the interactions among human agents who, unlike their chemical or biological counterparts, make conscious choices and decisions? The answer is that theories of self-organization apply not so much to the results of planned human activity, as to the non-planned collective consequences of human actions.

Hence, one of the important distinctions made by Braudel and MacNeill which bear on our question is that between centralized and decentralized human-decision making. While the activities of bureaucracies may be explained by reference to the decisions made by those who command them, and hence, without appeal to emergent phenomena,spontaneous order may still be displayed in human history as a collective, non-intended consequence of individual decisions made independently of one another. Braudel notices, for example, that prices across markets in Europe have displayed collective rhythms as far back as the thirteenth century, yet no one individual or bureaucracy was coordinating the activity in those markets to account for those rhythmic patterns.

2) An equally important idea contained in the work of Braudel, is that human history must be modeled as taking place at several scales of space and time going

on simultaneously: the scale at which interactions among individual decision-makers occur, the scale at which interactions among institutions take place, and the scale at which interactions between urban centers happen. While institutions may be said to emerge from the actual practices of individuals, once in place they acquire a life of their own, operating at a different spatio-temporal scale than the individual human beings that are their component parts. For instance, while it is true that the Venetian stock market emerged from informal encounters and exchanges among rich merchants, once its rules were formalized and it acquired a permanent building, the institution acquired a certain autonomy from those individuals, as is clear from the fact that it has not only outlived the original founders but many generations after them.

Similarly, urban centers may be seen as emerging from the interactions among institutions. Here Venice may also serve as example: it emerged from the consolidation of a number of pre-existing villages due to interactions among the institutional governments of those villages. Yet once formed, Venice acquired a certain degree of autonomy relative to any particular distribution of institutions and has outlived many of them. In other words, cities operate at their own spatio-temporal scale which is larger than that of institutions. The important point for our question is that processes of self-organization are more likely to exist at space and time scales that are large relative to those at which individual decision-makers operate, that is, at scales where individual choices have only a statistical effect.

3) Finally, there is the question of "turbulence" or "autocatalysis". In populations of inanimate beings (oscillating chemical reactions) or in those comprising organisms with hard-wired behavioral repertoires (ant colonies), self-organizing effects are almost invariably caused by some type of self-stimulating dynamics. This partly explains why old mechanistic versions of chemistry and biology failed to acknowledge the existence of emergent phenomena: self-stimulation increases the intensity of the parameters governing a dynamical system (an intensification which plays a fi crucial role) but classical science concentrated on low-intensity phenomena, precisely the type which fails to display self-organization.

In the case of human societies, central planners have almost invariably attempted to keep self-stimulation under control, out of fear that it may lead to runaway processes with hard to predict consequences. But, for the same reason, they have kept humanity in those low-intensity zones where self-organization simply does not happen. Only when an autocatalytic process imposes itself on those bureaucracies, taking them with it along an unpredictable path, do we see emergent forms that are not the result of deliberate human intervention. Perhaps the best example of such autocatalytic process is the arms races that have raged in the West for centuries, and that have made a planned, controlled, balance of power almost impossible to achieve. Arms races did not occur with the same runaway intensity in neither China nor Islam. {3}

Thus, there is only an apparent conflict between attempts to create a "social physics", where we can apply the insights derived from theories of self-organization to society, and our view of human culture as composed of conscious agents making reasoned decisions and choices. Both views are correct, and it is the very complexity of social processes that allows room for both. When the particular social event one attempts to explain occurs in fairly centralized institutions (capable of planning and monitoring compliance with the plans), at space and time scales comparable to those of individual human beings, and at relatively low intensities (so that centralized control is feasible), rational decision-making will be an important part of the explanation. Thus, in explaining the creation of a city like Versailles, planned to the last detail by the enormous bureaucracy under Louis XIV, planning and deliberate action will take center stage, and the beliefs and desires of certain individuals will become a key part of the explanation. On the other hand, whenever we have large numbers of individuals making decisions on their own, without central control, or when the scales of time and space are long relative to human scales, or when the intensity of material and energetic processes is high (due to autocatalytic effects), we will find that explanations in terms of the beliefs and desires of individuals will be less relevant. In these cases, to account for whatever patterns emerge in social processes we will need to use explanatory resources that go beyond questions of rational decision-making, and that connect human culture with physics, chemistry and biology.

At this point it may be useful to say a thing or two about these "explanatory resources". Without getting too technical we might say that, as far as their application to human history, the new sciences of self-organization and complexity may be divided into two main groups. One group (comprising nonlinear dynamics and far-from-equilibrium thermodynamics) deals with emergent collective behavior in populations of individual entities. The key idea here is that a large variety of different populations, that is, of populations composed of completely different individual entities, may display a strikingly common set of patterns. One such recurrent collective pattern is emergent rhythmic behavior. It may be displayed by a population of inorganic molecules in a periodic wi and (such as the Monsoon), and by populations of organic entities (such as yeast cells or amoebas). Moreover, the spontaneous rhythmic behavior of some technological objects (such as radio transmitters or radar machines) involves similar principles. But how can a periodic pattern be instantiated by such a varied group of entities? And even if we can assert empirically that these processes do share a pattern, how can we know that it is the same pattern? After all, given the completely different causal mechanisms behind the activity of winds, amoebas and radio transmitters, to think that their periodic behavior shares an underlying principle stretches the imagination.

As it happens, the mathematical explanation for these rhythms has turned out to be exactly the same. Technically, the collective dynamics of all these different populations are said to be governed by the same "periodic attractor". An attractor is an endogenously generated stable state which draws all dynamics towards it (i.e. it "attracts" the dynamics) and which depends for its existence on a flow of energy

of sufficient intensity. A periodic wind, a pulsating amoeba colony, a vibrating radio transmitter, all begin their stable cyclic dynamics at a critical point in the intensity of a flow of energy (solar, chemical and electrical energy, respectively), and all cease to display this coherent collective behavior once the intensity drops below the critical threshold. For our purposes here all that matters is that one and the same explanation (in terms of attractors) is valid for a wild variety of different processes. And moreover, it is precisely this versatility in the type of physical embodiments which an attractor may have which makes it plausible that human populations might also embody the same stable cyclic state. The periodic behavior of prices in decentralized markets, for example, and a number of other cyclic economic phenomena, may be explainable in terms of attractors. If this turns out to be true, the existence of a threshold of intensity below which collective rhythmic behavior does not arise may explain why self-organization does not exist when the command element in the mixture is too high: centralized planning may keep human populations away from the minimum intensity.

At any rate, what is really striking in explanations in terms of attractors is that one and the same "abstract form" (a closed loop in the abstract space of possibilities for a dynamical system) may be realized or actualized by such divergent populations of entities. The second group of sciences of self-organization (comprising Artificial Life as well as the so-called science of "memetics") also displays this property of divergent actualization. Here one begins with the basic Darwinian insight: that a population of organisms which reproduces with enough variation and which is subject to selection pressures (from climate, predators, parasites etc.) can evolve new forms. This insight has now been made abstract enough to be applied to any population of replicators (not just genetic replicators) coupled to any kind of sorting device (not just natural selection). Thus, the virtual animals and plants studied by Artificial Life can indeed replicate within a computer, and humans acting as "animal-breeders" can guide this evolution towards the production of useful computer programs. Moreover, the divergent actualizations of the abstract process "variable replication-sorting device" are not confined to the virtual environments one can create within a computer. Any pattern that variably replicates itself, it does not matter how, and that is subjected to any kind of sorting process, will display similar evolutionary dynamics.

Thus, certain behavioral patterns (of which perhaps the best example is bird songs) which are transmitted from one generation to the next by imitation, can perform the role of replicators. These patterns, called "memes", can also be found in human culture, and underlie the propagation of fashions and fads, as well as the spread of some technical innovations. On the other hand, most cultural patterns that are constitutive of particular societies (such as the sounds, words and grammatical rules that form a given language) do not pass from one generation to the next by imitation, but by socially-enforced, obligatory repetition. They are social norms, not memes, but they nevertheless instantiate the abstract role of "replicator". (The importance of the distinction between memes and norms is missed by most

contemporary writers, who think of "memetics" as a science of cultural replicators in general.)

What matters to us here, however, is that some cultural phenomena that occur at time scales too large (and in too decentralized a form) to be explained by individual decision-making, can be explained in terms of evolutionary dynamics involving populations of replicators. Here perhaps the best example is the transformation of Old English into Early Middle English during the Norman invasion of England at the beginning of the millennium. In this case, a population of peasants transformed the language, in about twelve generations, without any central authority directing them, by clipping away most inflections that expressed grammatical functions, and hence mutating English from an inflected dialect of German to the uninflected form it still has today. The process took so long, however, that we may say the language evolved from one state to the other in a process of self-organization. This spontaneous evolution may be contrasted with the creation several centuries later of standard forms for English which involved central planning and deliberate institutional interventions. (In the case of French and Spanish this process involved specialized institutions, Academies of Language, which used dictionaries and artificial grammars to engineer standard versions of their otherwise self-organized languages.) The third element of our explanation (high-intensity) is here represented by the intensity of variation (or mutation rate) in the replicators: the Norman invaders removed an emerging standard (West Saxon) which, like any standard, reduced the intensity of variation, and therefore increased the amount of allowed linguistic experimentation among peasant populations.

Thus, both branches of the sciences of complexity and self-organization have useful insights that can be applied to a reinterpretation of human history, as long as we keep in mind the areas of culture (decentralized or large spatio-temporal scale or high intensity) where these insights are valid, and do not try to extrapolate them to other areas where their validity may be questionable. I have myself attempted such a reinterpretation in my book "A Thousand Years of Nonlinear History", and I leave it to the readers to judge for themselves whether this attempt has been successful or not. {4} But despite the fact that my application of these insights may have shortcomings, it is my firm belief that the insights themselves are here to stay, that large portions of human history share underlying patterns with non-human processes, and that this humbling realization will form an integral part of any attempt to invent new destinies for humanity.

References:

{1} Fernand Braudel. Capitalism and Material Life 1400-1800. (Harper and Row, New York, 1973). p.396-397

{2} William H. McNeill. The Pursuit of Power.Technology, Armed Force and Society since A.D. 1000. (University of Chicago Press, 1982). p. 49 (My italics).

{3} Paul Kennedy. The Rise and Fall of the Great Powers. (Random House, New York, 1987). p. 22-23

{4} Manuel DeLanda. A Thousand Years of Nonlinear History. (Zone Books, New York, 1997).

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